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RADIATION MEASUREMENTS DURING THE FLIGHT OF THE THIRD SOVIET COSMIC ROCKET

(Izmereniya radiatsii pri polete tret'yey kosmicheskoy rakety)

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A special apparatus for registering fast charged particles and photons was installed aboard the third cosmic rocket launched on 4 October 1959. It consisted of a scintillation counter and three gas-discharge counters. All the latter, whose operating dimensions are 1 by 5 cm^2, had a wall thickness of 50 mg/cm^2 made of steel, and were surrounded by additional screens of various composition and thickness. Counter I was located in a screen made of 3 mm lead and 1 mm aluminum, with a 0.28 cm^2 window closed by a 0.2 mm aluminum foil. Counter II was installed in a 2.5 mm aluminum cases. The scintillation counter, with a sodium iodide crystal 39.5 by 40 mm and surrounded by an aluminum layer 1 $g.cm^2$ thick, registered the total ionization created by the radiation in the crystal and the pulse counting rate corresponding to energy emissions greater than 45 keV for the first threshold, and above 3.6 MeV for the second threshold.

The pulses of the scintillation and self-extinguishing counters' outputs were transferred to conversion (scaling) circuits, whose entries were transmitted by radio. The transmission of counters' readings was made once in a 24-hour period during one hour, and this allowed to determine with a good degree of precision the radiation intensity during the rocket's flight through radiation belts, as well beyond the limits of the Earth's magnetic field. In the interval between sessions all the counters of the third rocket, with the exception

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of III, remained switched on, and continued to register the radiation. The large volume of scaling circuits *) allowed to determine the overall dose registered by the instruments between two sessions with a great precision.

The accuracy of the overall dose registration, and correspondingly that of the mean intensity, depends upon the time interval between sessions, and tends to improve as this interval increases. Under good reception conditions, and with a 24-hour interruption, the measurement precision of the mean intensitywas 0.1 percent. However, at greater distances from the Earth the quality of the reception was not always as high on account of the smallness of the signal received. That is why the precision of the results obtained was not highest in certain cases, and in the final computation of the mean intensity, only the most reliable sessions were taken into account.

The preliminary results of data processing of instrument readings for the period 4 to 18 October 1959 are here presented. The first radio transmission took place for twenty minutes during rocket take-off. During that lapse of time the rocket climbed from 7,500 to 14,000 kilometers, the distances being counted from the center of the Earth. The next transmission took place 10 hours later and lasted about one hour. During that time, the rocket has reached the 130,000 km. height, and was thus already beyond the Earth's radiation belts.

Table 1 next page presents the radiation doses registered by certain instruments of the third cosmic rocket during its flight through the outer radiation belt. As a matter of comparison, radiation doses registered by similar devices aboard the first and the second space rockets are also presented.

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*) The first filling of computer I scaling circuit at radiation intensity corresponding to cosmic rays, took place for 4 days, that of counter II — for 24 hours, that of the scaling circuit of the first threshold of the scintillation counter for 4 days, and that of the second threshold — for 24 hours. Finally, the total filling of the scaling circuit for the ionization measurement — for 100 days.

It must be pointed out that the accuracy of the values of doses and mean intensities corresponds to the precision of device readings' deciphering. Because of the inaccuracy of their graduation the true values cannot differ from those brought forth in this work by more than 5 percent. Doses compiled in Table 1 are those obtained after substracting the cosmic ray background.

T A B L E 1.

Date	Intensity shown by the gas-discharge counters (freq/cm^2)		Total ionization in a crystal of 180 g (eV)	
	inside *	outside	inside	outside
2.I. 59			$9.4 \cdot 10^{14}$	
12.IX. 59	$3.74 \cdot 10^5$ ** $2.37 \cdot 10^5$ ***		$13.4 \cdot 10^{14}$	$3.83 \cdot 10^{15}$
4.X .59		$2.65 \cdot 10^5$	$8.4 \cdot 10^{14}$	

* The container's wall of the first, second and third space rockets ad a thickness of 1 g/cm^2.

** Counter located under a 1.5 mm copper screen

*** Counter located under a screen made of 3 mm lead and 1 mm aluminum.

The flight trajectories and motion velocities for the first, second and third rockets differed little from one another. That is why the doses presented in Table 1 reflect the true values of particle flux intensity in the outer zone during its crossing by the rocket.

The comparison of the values of the total ionization presented in Table 1 show that the conditions in the outer zone on 2 January and 4 October differed little from one another. On 12 September a rise of the total ionization in the crystal was registered.

Its value was about 1.5 times that of the preceding two. Table 1 also shows that the particle intensity registered by the instruments of the rocket depends upon the absorption in the walls of the container. This follows from the comparison of the indications of the scintillation counter on 12 September, inside and outside the container, and also from the comparison of gas-discharge counter readings for 12 September and 4 October.

The analysis of data provided by the operations of the third rocket's instruments from 4 to 18 October, during the rocket's flight in interplanetary space, allowed the determination of cosmic ray intensity, undistorted by the influence of the magnetic field, and of the Earth's atmosphere. The mean intensity for the period 4 to 18 October was 2.12 fr/cm^2-sec, as measured by counters I and II. The average pulse count rate with a threshold energy of 45 keV was 6.79 pulse/cm^2-sec, and with a threshold energy of 3.6 MeV — 2.15 pulse/cm^2-sec. The mean ionization for the whole crystal, and for the indicated interval was 1.56 10^9 eV/sec. The mean intensity values obtained in the present work agree well with the data provided by the flights of the first and second cosmic rockets [1].

The accuracy of instrument readings permitted to establish that the intensity of radiation beyond the Earth's magnetic field was quite constant during the first 14 days of flight. Only in isolated cases were minor variations of the "daily-mean" intensity registered (intensity averaged to the time between two sessions).

Fig. 1 next page presents the "mean-daily" intensity as it results from gas-discharge counter II readings. To compare these readings with the intensity of cosmic rays in Figure 1., plotted are neutron monitor readings, averaged for the time between sessions [2]. They serve in the determination of the mean-daily intensity (the monitor readings utilized are averaged for 2 hours, and corrected from the barometric effect, the monitor being located at sea level, 55.5° lat.N, and 37.3° long.E.)

It results from Figures 1 a, and 1 б , that all registered intensity variations by the instruments of the third rocket are in qualitative agreement with monitor readings. There could be no precise correspondance between the cosmic ray intensity measurements of the 3rd rocket's instruments and of the monitor, for averaging intervals of the counter on the rocket and of the monitor coincided only partially It follows from the comparison of Fig. 1 a and 1 б , that the cosmic ray intensity variations registered by the counter do not exceed 10 percent, while those registered by the monitor do not exceed 2 percent

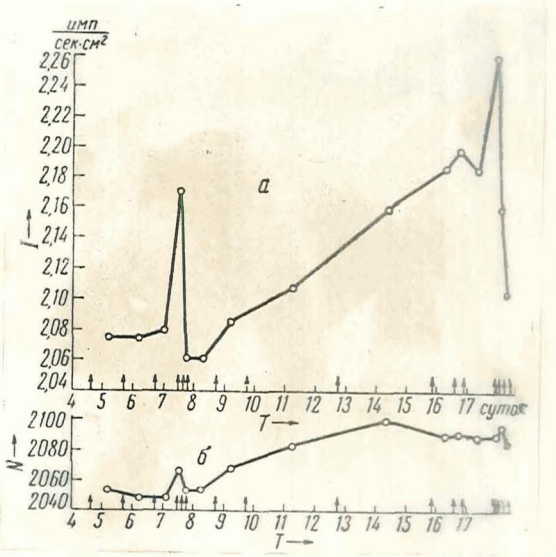

Fig. 1

I is the "mean-daily" intensity according to gas-discharge counter II readings ; N is the 2-hour readings of the standard neutron monitor, averaged time between sessions ; T is the date(Oct.1959) The arrows on the axis T indicate the time of the sessions, utilized in the determination of the "mean-daily" intensity.

Since the neutron monitor's showings are sensitive to primary particles with energies of 10^9 eV (critical energy determined by the magnetic field), and counter II registered protons with 50 MeV energies, it may be concluded that the intensity of particles indicing the variations changes fivefold with energy variations from $5 \cdot 10^7$ to 10^9 eV. The relative brevity in intensity variations registered on 7 and 18 october, points to the relationship of these variations with the solar activity. In this case the observed intensity variations may be explained by variation in intensity of cosmic rays generated by the Sun, [3] as well as by the effect of magnetic fields erupted by the Sun, on cosmic rays originating elsewhere.

In view of the fact that the particle spectrum is substantially harder at the observed intensity variations than in case of cosmic ray emission during flares, it seems rather improbable that the observed variations are the result of particle generation in the Sun. Apparently, if favorable conditions for high-energy particle generation appear on the Sun, their intensity is very high, and in most cases it surpasses that fo cosmic radiation. As to the weak variations observed during the period from 4 to 18 October, they are most certainly linked with the variations of solar system's magnetic fields, and with their action on the intensity of cosmic rays originating from without.

**** E N D ****

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